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A Study on the Impact of Diet on Unified Fire Authority Firefighter Performance

By Marin Easton

**Capstone submitted in partial fulfillment
of the requirements for graduation with
University Honors**

With a major in Dietetics in the Department of Nutrition, Dietetics and Food Sciences

Approved:

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Abstract:

Objective: This project aimed to examine the impact of nutrition knowledge, dietary intake, and physical activity on firefighters' performance on their routine physical assessment (RPA).

Methodology: Members of the Unified Fire Authority, the largest fire agency in Utah with more than 400 sworn firefighters serving 15 communities representing 440,000 residents, were invited via email to participate in this cross-sectional study. Participants (N=92) completed a 40-question survey that assessed specialized diet adherence, dietary intake, nutrition knowledge (using questions from the General Nutrition Knowledge Questionnaire; 1 point for each correct answer [26 points possible]), regular physical activity (International Physical Activity Questionnaire), and perceived physical performance on their RPA. Based on their responses, participants were categorized into one of two groups: High Performance (performed exceptionally well/very well) and Lower Performance (performed moderately well/slightly well/not well at all). Chi Squared Distributions and Independent t-tests were used to assess group differences. Statistical significance was set at $p < 0.05$.

Results: More High Performance firefighters reported eating ≥ 5 servings of fruits and vegetables (29.2% vs 10.8%, $p=0.04$) than Lower Performance firefighters. There were no significant differences in prevalence of vigorous physical activity (12.1% vs 17.8%, $p=0.27$), prevalence of following a specific diet (27.1% vs 21.6%, $p=0.57$), or nutrition knowledge score (18.7 vs 18.2, $p=0.49$) when comparing High Performance and Lower Performance firefighters.

Conclusions: High Performance firefighters had a higher prevalence of fruit and vegetable consumption. Diet quality, including intake of fruits and vegetables, should be an included strategy for firefighters wishing to improve their physical performance. Future studies should use

interviews and lab-based assessments to further assess factors that may influence firefighters' performance on RPAs.

Acknowledgements:

First of all, I would like to thank my mentor, Dr. Katie Brown. Her extraordinary patience and kindness throughout this project kept me pointed in the right direction. I would not have been able to complete this project if I did not have someone as involved as her. Her feedback has always been so kind and gave me clear methods to improve. She provided me with enough fundamental understanding of dietetic community needs research to bring this project to fruition.

Secondly, I would like to thank Unified Fire Authority for their assistance with this project. I appreciated having a connection to a fire department willing to let me prepare and send out this survey.

I am also grateful for my time doing undergraduate research with Dr. Scott Hunsaker. Because I had completed the required honors contract hours in my research with him, I was able to complete my capstone, even with the rigor of the coordinated dietetics program. Without his help, I wouldn't have even tried. He taught me basic skills of data analysis and how to present research.

I would also like to thank my departmental honors mentor Rebecca Charlton for her time and involvement. In addition, I would also like to thank the other members of the Honors Department for the opportunity to work on this capstone project.

Lastly, I would also like to thank my family for their involvement. My mom knew about Honors from her own experience and encouraged me to fill out the application. My dad facilitated my interest in firefighters and gave me the idea of becoming a dietitian. My husband gave thoughtful advice and excellent moral support.

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Introduction:

First responders have very physically rigorous jobs. The fitness of their body can impact their ability to save lives. Nutrition is a key component in physical fitness. First responders, like firefighters, are an ideal community to survey on diet and physical performance. Fire departments in several states have begun hiring dietitians/nutritionists on staff to help implement nutrition programs for firefighters. If a department is considering hiring a dietitian/nutritionist, they should consider how healthy dietary habits can benefit physical performance.

Poor dietary habits can lead to a hazardous work environment for firefighters. Cardiovascular disease is the leading cause of on-duty death and lifetime mortality among United States firefighters. An estimated 45% of on-duty fatalities are from sudden cardiac death (Soteriades et al., 2011). The second leading cause of death is cancer, accounting for 27% of lifetime mortality among US firefighters (Daniels et al., 2014). Research suggests that firefighters have increased risk for several types of cancer compared to the general public, primarily digestive and respiratory cancers (Daniels et al., 2014). Current research also shows a growing trend in obesity for firefighters (Baur et al., 2012). Research by Soteriades et al. (2011) also found that much of this is believed to be attributed to the worldwide obesity epidemic, sedentary behavior and high caloric communal meals involved in “firehouse culture” and the frequent consumption of fast food and sugar sweetened beverages.

Lifestyle habits involving diet and physical activity are a major component to one’s health. Dietary interventions have been shown to have a positive impact on health outcomes (see discussion). With this in mind, assessing firefighters’ lifestyle habits and nutrition knowledge is vital to planning proper dietary interventions. Their physical fitness is key to their ability to perform their job duties and save lives.

Firefighters at UFA are required to take part in a routine physical assessment (RPA). This assessment has seven components; the hose drag, hydrant connection, roof ventilation, maze crawl, dummy drag, stair climb with hose bundle and the ladder raise. Each of these sections are meant to test the agility of a firefighter to ensure they would succeed if faced with similar physically intensive challenges on the job.

Methodology:

Researchers prepared an introductory email and link to a 40-question survey which was sent to the Head of Health and Safety at UFA. They distributed the email and link to all 430 firefighters currently employed at the organization with an invitation to participate in this cross-sectional study.

The survey assessed specialized diet adherence, dietary intake, nutrition knowledge, regular physical activity, and perceived physical performance on their RPA. The first two questions were on specialized dietary adherence to see if the participants were taking part in any specialized diets such as keto, Atkins, intermittent fasting, vegan, etc. This was followed by sixteen questions on dietary intake focusing on the types and frequency of foods eaten throughout the day, meals and snack frequency, alcoholic beverage intake and caffeinated beverage intake. There were two questions gathering anthropometric data (height and weight) in order to calculate BMI. There were eleven questions for general nutrition knowledge, with some being broken up into multiple ranking questions. The questions asked if Americans should eat more, less or the same amount of certain foods, how many servings they believed were recommended, some nutrient specific questions (i.e.: which of these foods is a good source of protein...) and whether they agreed or disagreed with certain statements. These questions were

taken from the General Nutrition Knowledge Questionnaire (Kliemann et al., 2016) This section was scored giving 1 point for each correct answer, with 26 points possible.

The next section of the survey assessed regular weekly physical activity with questions taken from the International Physical Activity Questionnaire (IPAQ) (Hallal & Victoria, 2006) and contained three questions, with follow-up questions if they chose to answer. The questions were used to determine the type of exercise (vigorous, moderate, light) and the estimated weekly amount. There were three questions regarding how firefighters perceived their own performance on their RPA. One question had participants rank how they felt they performed with each individual task from extremely well to not very well at all. Finally, there were three open ended questions in the survey asking for feedback and commentary.

Based on their responses regarding perceived physical performance, participants were categorized into one of two groups: High Performance (performed exceptionally well/very well) and Lower Performance (performed moderately well/slightly well/not well at all). Chi Squared Distributions and Independent t-tests were used to assess group differences. IBM SPSS, version 26, was used for all statistical analyses (IBM Corp 2019). Statistical significance was set at $p < 0.05$.

Results:

Ninety-two fire fighters participated in the study. Of those, eighty-five chose to participate in rating their performance. Forty-eight (51%) participants were rated Higher Performance firefighters and thirty-seven (39%) were rated Lower Performance firefighters. The remaining 10% did not receive a rating because they did not complete the section. The most statistically significant finding was that more High Performance firefighters reported eating ≥ 5 servings of fruits and vegetables (29.2% vs 10.8%, $p = 0.04$) than Lower Performance firefighters.

There were no significant differences in prevalence of vigorous physical activity (12.1% vs 17.8%, $p=0.27$), prevalence of following a specific diet (27.1% vs 21.6%, $p=0.57$), or nutrition knowledge score (18.7 vs 18.2, $p=0.49$) when comparing High Performance and Lower Performance firefighters (see Figure 1).

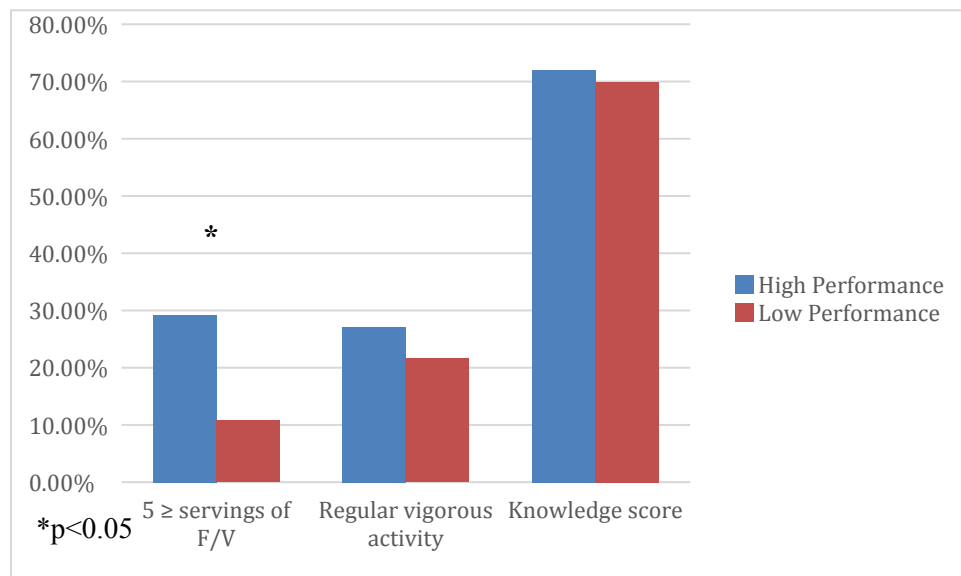


Figure 1. Firefighters’ Fruit/Vegetable Intake, Regular Physical Activity Level, and Nutrition Knowledge Score by Physical Performance Category.

The survey results also showed that 22.87% of participants were involved in some kind of specialized diet. These diets varied with only 1-3 participating in any specific one. The highest number of participants following an individual diet was 3.3% taking part in intermittent fasting. Of those adhering to a specific diet, 43.9% reported very strict adherence, 52.2% reported somewhat strict adherence and 4.7% reported not very strict adherence. There was no significant difference in the percent of firefighters who followed a specific diet who felt they performed very well or exceptionally well on their fitness vs those who did not perform as well (27.1% vs 21.6%, $p=0.57$) through this difference (see Figure 1).-

One of the questions asked participants if they wanted to know more about a nutrition topic. Of those who answered the question 35.3% stated they did not feel the need to learn more and 64.7% expressed interest in one or more nutrition topics they wished to learn more about. Another question asked if they agreed or disagreed with standard dietary recommendations and to please explain their answer. Of the participants who answered this question, 42.6% disagreed with various reasons why. Only 27.9% stated that they agreed with standard dietary recommendations. The remaining responses were considered neutral. One of the comments in response to the prompt, “Do you have any comments you would like to share with the researchers?” stated, “Often when working at the station, it is easy to eat bad food. The busier we are and the more Adrenalin dumps I have, sugary foods become easier to reach for.” Most other responses to this prompt shared individual information (weight loss, age, % body fat, etc.), expressed gratitude or concern over the survey content or made a request (additional exercise equipment for stations).

Discussion:

There is limited literature on nutrition assessment studies regarding firefighters. The research available is primarily focused on promoting health or weight change. No studies so far have been performed on UFA firefighters, which includes more than 400 firefighters in 16 communities in the greater Salt Lake City area. This discussion will compare similar studies to the results of this survey to provide a better perspective on the dietary/physical behaviors of firefighters and their needs.

As mentioned before, more High Performance firefighters reported eating ≥ 5 servings of fruits and vegetables than Lower Performance firefighters. This finding aligns with findings from intervention studies utilizing diets high in plant-based foods, such as the Mediterranean diet

(Manzano-Carrasco et al., 2019). In this study examining the impact of introducing a Mediterranean diet intervention to male football players, results showed that those with greater adherence to the Mediterranean diet were associated with better cardiorespiratory fitness and handgrip strength (Manzano-Carrasco et al., 2019).

The UFA survey results showed that 74% of UFA firefighters follow a specific diet. The findings from the current study were similar to findings from a study by Yang et al. (2015). Of the 3,657 firefighters surveyed, 71% denied following any specific diet. The Mediterranean diet was most often ranked as the favored diet compared to other types of diets (Yang et al., 2015). According to the U.S. Centers for Disease Control and Prevention's NCHS Data Brief, the population average for following a specific diet in the U.S. was 17% (Weinandy, 2020). According to this data, a higher percent of firefighters follow specific diets than the average population.

UFA firefighters' free-responses comments indicated that their diet quality decreased when they were working at the station, due in part to the high-stress nature of the job. This sentiment agrees with the findings of a study of Spanish firefighters (López-Bermudo & Gómez-Landero, 2021). López-Bermudo and Gómez-Landero (2021) found that the dietary habits of firefighters were observably different depending on whether they are on shift or off. On-duty firefighters tended to consume more calories and had a higher intake of fats than those who were off duty. Another focus group-based study reported that firefighters' unhealthy eating is while they are at the fire academy (Sotos-Prieto et al., 2019). Most fire stations and academies have an onsite cafeteria. Firefighter recruits at academies that do not have an onsite cafeteria mentioned eating out more often and buying snacks from a vending machine. Only one of the academies in

the study had a dietitian onsite. Overall, the literature appears to show that firefighter dietary habits tend to be poorer when they are onsite rather than when they are off shift/at home.

Previous research indicates that firefighter fitness influences their ability to perform their jobs. Most often, firefighter fitness is assessed by having firefighters complete work-related tasks; this approach helps minimize the confounding effects of biological variability (Boyd et al., 2014). A study done in Illinois examined how regular exercise impacted firefighter health and firefighting ability (Chizewski et al., 2021). The findings of this study suggest that cardiovascular endurance and muscular endurance were the strongest predictors for completing firefighting tasks quickly. A study by Xu et al. (2020) reported that those who had better health parameters (weight, maximum oxygen uptake, body fat percentage, upper body muscular power and lower body muscular power) performed better on specialized firefighter tasks (rope climb, run 200 m round trip with load, 60 m carrying a ladder, climb stairs with load, evacuation of 400 m with supplies, run 5 km with an air respirator, run 100 m with the water hose). This demonstrates the importance of maintaining regular physical exercise. Responses from the UFA survey showed that engaging in regular vigorous exercise might have improved physical performance. However, because the p-value was greater than 0.05, the difference was not considered significant. This may have occurred from this study because of the qualitative nature of this study. To have more significant results, a more accurate measuring technique should be used for the measurement of regular physical activity and physical performance.

In the current study, no difference was observed in participants' nutrition knowledge when comparing High Performance firefighters and Lower Performance firefighters. A score of approximately 70% on the nutrition knowledge questions suggests a need for additional nutrition education. Sotos-Prieto et al. (2019) reported that 33% of firefighter recruit participants reported

very little to no nutrition education. Yang et al. (2021) reported that of the firefighter recruits, 68% felt they did not receive enough nutrition information, and 75% expressed interest in learning more about healthy eating. These findings highlight the need for nutrition education interventions.

One such intervention study that took place educated a group of firefighters on healthy dietary habits consistent with the Mediterranean diet (Sotos-Prieto et al., 2017). This study compared the intervention group to a control group using a food frequency questionnaire and medical records. Another nutrition education-based study presented six 90-minute nutrition education and cooking demonstration sessions (Goheer et al., 2014). This study was intended as a weight loss intervention but did not show a change in BMI of firefighters. It was ranked as helpful in improving dietary habits of firefighters and their families by the participants in a follow up survey.

Dietary intervention studies for firefighters tend to focus on using weight change and biomarkers as methods of determining the impact of the intervention. A dissertation by a Mississippi State University student involved a 28-day low carbohydrate diet intervention in Mississippi firefighters (Walder, 2019). It examined firefighters' cardiometabolic markers and assessed their risk of cardiovascular disease while following a set low carbohydrate diet. The results suggested that following a low carbohydrate diet decreased markers of cardiovascular disease and improved performance on their bi-annual fitness assessment (Walder, 2019). A randomized controlled trial study assessed the effect of a specific health-based web program on weight change among firefighters (McDonough et al., 2015). The intervention program showed an average weight loss for participants between 2.3 to 3.1 pounds among those who were overweight or obese over the course of six months. Those in the control condition had gained

weight over time. The results suggest that the low carbohydrate dietary intervention reduced obese and overweight firefighters' weight (McDonough et al., 2015). This shows that there is potential for a future low-carbohydrate diet intervention-based study for UFA firefighters to further look at how it would affect their physical fitness and biomarkers.

A study with members of the Indianapolis Fire Department involved focus groups set out to determine what kinds of nutrition interventions could reduce cardiovascular health risks (Muegge et al. 2018). The results suggested that the participating firefighters tended to eat fattier, more affordable meals with little to no produce while on the job, which was similar to the results described by López-Bermudo Gómez-Landero and the comment in the UFA survey results. In the research done by Muegge et al., they reported healthier meals when at home. This suggested that a dietary intervention would be most effective if it accounted for firefighter tradition and cultural norms, limited food choice, food cost and portion sizes.

Conclusions:

The survey's findings suggest that good dietary habits, such as a higher intake of fruits and vegetables, may have a beneficial impact on physical performance. The results suggest that improving diet quality, especially through increased intake of fruits and vegetables, could be an effective strategy for firefighters wishing to improve their physical performance. More studies would need to be done to be conclusive.

For future studies, it is recommended to utilize interviews and lab-based assessments to further assess factors that may influence firefighters' performance on RPAs. A more hands-on approach could be beneficial to get better quantitative and qualitative data. Having interviews or focus groups would provide the opportunity to ask follow-up questions and get more detailed and personalized responses. Using lab-based assessments such as hand grip strength and muscle mass

assessment could provide more objective data rather than relying on how individuals perceived their own performance. It would also be beneficial to have a scoring system for the RPA to measure physical performance rather than having them self-report.

Studies seeking to improve firefighter fitness through nutrition should consider nutrition education interventions. Something similar to what Sotos-Prieto et al., 2017 did with their nutrition education could have beneficial results. The importance of a high intake of fruits and vegetables on physical fitness was demonstrated in the results of the UFA survey. Providing an education on a dietary lifestyle with a high amount of fruits and vegetables could have potential in improving physical performance. This could be done in a style similar to the Goheer et al. 2014 study, a combination of cooking demonstrations and educational presentations performed several times over several weeks. A future project modelled in these styles could potentially improve UFA firefighter performance.

Reflection

Completing this honors capstone has been a journey that luck and happenstance have played as much of a role in as hard work. I am so very grateful that Dr. Katie Brown was willing to help me out with this when I asked her to be my mentor back in fall 2021. In an Honors capstone timeline, that is pretty last minute. She was so kind and quick in helping me get going on this project. She definitely went above and beyond the requirements for a mentor over the course of this project and there is no way I can thank her enough.

I did not think that I would ever complete my honors capstone. My first couple of years at USU, I did not think I was smart enough to be a part of the Honors Program. I even expressed this at my first meeting with the Honors Advisor. She directed me to meet with my departmental advisor, Dr. Hunsaker. In the meeting I had with him, he offered me a paid position as an undergraduate researcher. Since I was looking for a job anyway, this was perfect. Because of that experience, my academic confidence improved and I completed my necessary Honors Contracts.

By the time I had switched my major to Dietetics, I had all the hours necessary to graduate with Honors (excluding the capstone project). I had not initially planned on completing my capstone, however, realizing I had enough hours, I thought I could at least try. I was impressed with Dr. Katie Brown's research with our graduating class based on dietary needs of dietetic interns that we would be doing over the next year. I told her about my newfound desire to graduate with Honors. I told her about my idea for a project and she agreed to be my mentor.

The first step needed for this project was to contact a fire department. I fondly remembered my ride-along with UFA and my dad works as their Director of Communications. He put me in contact with the Head of Health and Safety who was able to get me permission to send out a survey. I was also able to ask about the expectations and potential topics regarding the

study. I learned about their routine physical fitness exam. While communicating with UFA, I learned that many fire departments have begun considering hiring dietitians. I found this motivating because it reassured me that others are aware of the nutritional needs of firefighters.

One of the biggest challenges I faced was meeting deadlines. Fortunately, I had given myself plenty of wiggle room but life events and occasional difficulty with communication slowed the process more than initially anticipated. In the beginning of this project, I had wanted to have more involved research. As mentioned in the conclusion, I had originally planned to be more hands-on. We had discussed the possibility of gaining access to participating firefighters' medical records and comparing survey/interview results to their yearly physical fitness check-up. This would have provided quantifiable data, however the process to get this data required signed permission from each participant. In order to meet time constraints, the survey was made completely anonymous and the fewer barriers we had to cross the better. If this project had been started the year before, I think this could have been more feasible.

Fortunately for me, one of the classes taught by my mentor this last semester had a focus on dietetic research. I was able to learn what I needed for this project alongside my classmates for our group project. This particular project falls into the category of a community needs assessment because the goal of the research is to better understand where gaps are in what a community has access to. In this case, it was to see how diet and exercise habits can influence the physical fitness of firefighters.

When presenting this research at the Utah Academy of Dietetics and Nutrition conference in March 2022, I was selected as an award winner for the Outstanding Abstract (Undergraduate). However, I had been eating lunch outside with some peers while the award ceremony was taking place so someone had to run out and get me. I think running from outside to the stage made an

impression because several people approached me afterwards to talk about it. I don't know if winning an award or making a scene is what led to the interest, but presenting research at conferences is a great way to network with colleagues. I was given contact information to dietitians who have done similar research in other states with firefighters. I also met someone who did similar research with police officers.

I was glad for the chance to both broaden my understanding of research and dietetics as a profession. I learned about other types of community needs surveys and methods of assessing physical fitness. Much of what has been studied in the past appears similar to sports nutrition, which is a popular field of dietetics. I enjoyed connecting with other dietitians who have done similar research.

I was grateful for my opportunities to engage with a community, design a survey specifically for them, and then present the findings. After collecting the results of the survey, I had several opportunities to present a poster. I was also able to share my findings with the UFA Head of Health and Safety, as well as some resources they could utilize to improve dietary habits. In the future, I may consider furthering this project into a masters' thesis. If that is the case, I would love to implement some of the methods I mentioned previously. Another type of research I would love to utilize is intervention-based research.

Knowing now that the most significant result of the survey was that more High Performance firefighters ate more servings of fruit and vegetables, implementing an intervention to try and increase fruit and vegetable intake could be effective. I would love to see what methods would be most effective to help firefighters improve nutrition habits. It would also be interesting to look at connections to mental health in addition to physical ability, especially with

firefighters struggling with substance abuse. I also think that fire departments would be more interested in research that is application-based rather than just informative.

Overall, my experiences with undergraduate research have been both educational and gratifying. I have enjoyed working with extremely intelligent mentors who are willing to spend time helping me develop my undergraduate education experience. I have learned a lot about developing a research question into an actual project. I hope that other dietetics students will be inspired to participate in Honors and complete a capstone project. I am exceptionally grateful for my time with the honors program at USU and the opportunities that have been provided.

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Author Bio

Marin started at USU with the intention of becoming an elementary school teacher. She started doing undergraduate research in this field. Even though her interests shifted to Dietetics and Nutrition, her interest in research remained. She happened to earn an unplanned art minor after taking several art classes as a side hobby. Along with being involved in honors, Marin is a Community Engaged Scholar. She spent three years working for University Housing as a Resident Assistant and loves being involved in campus life.

She did a ride along with Unified Fire Authority in 2018 when she was considering becoming an EMT. She was very curious about their dietary habits after noting that several of the firefighters she was with had specialized diets (vegan, keto, etc.) When she started the dietetics program at Utah State that was a subject she wanted to continue to learn about.

As a graduation trip/late honeymoon she and her husband are planning to backpack in Europe for two and a half months. Her husband is starting his PhD program at Notre Dame University Fall 2022, and they will be moving to South Bend, Indiana shortly after their trip. They have already put offers on a few houses. Marin is planning on starting work as a dietitian and getting her masters' degree online.